Exhibit D

TTY Forum

Seeking Solutions to TTY/TDD Through Wireless Digital Systems
TTY/TDD FORUM - 6

Final Report
(September 21, 1998)

July 21-22, 1998
Washington, DC

- We need to move our focus from testing to resolving the issues of equipment and interfaces.
- Use Gallaudet staff to review test scripts to determine a fair shift error number.
- Recommend that the error rate be addressed in the test suite. The users are actually saying that by having shift errors be counted as a string of errors rather than cutting them off would make the results look worse.
- Add wireline matrix to script to determine wireline shift error rate as a benchmark.
- Issue Statement:

The issue of the false propagation of errors, created by the incorrect receipt of a shift character should be addressed through use of an appropriate test script. The script should contain multiple shifts space apart so that a realistic distribution of character errors would result, based on frequent (although not universal) practice of correcting shift errors by user action. A normal distribution between 1 and ? with a median of about 8 would be appropriate.

15. CONSUMER POINT OF VIEW DOCUMENT: CRITERIA FOR ACCEPTANCE OF "ONE PHONE MODEL PER SERVICE PROVIDER AS OF OCTOBER 1, 1998" PROPOSAL

Document describes consumer criteria for phones and the circumstances of their availability to allow consumer support of the one digital model per service provide per service to meet the FCC requirement for compliance by October 1, 1998. These are a set of user conditions and include HCO/VCO, if it cannot be done, the FCC would like clarification of the reasons.

Discussion:

- As clarification of the intent of this document, this is a statement of the desired features and actions.
- Propose a preamble to the document that states that this is not a set of requirements
- Karen Straus – Clarification of the document is that it is the criteria for acceptance of the one phone per service provider compromise. We would need to know why we can't have these features or items.
- State that this is a contribution by consumers as an opening point of discussion.
- Public safety had a wish list which had to be prioritized to allow the industry to achieve the items in sequence.
- To put this document forward as a list of requirements at this late date is unfair.
- If it is offered as a point of discussion then this is the spirit that it can be dealt with.
- Karen Straus – We see this as grounds for acceptance. We are looking for feedback.

Andrea Williams – This is a problem if this goes into the public record as the criteria for consumers since some carriers have stated off-line that there are

Meeting adjourned.

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Exhibit E

TTY Forum

Seeking Solutions to TTY/TDD Through Wireless Digital Systems
TTY/TDD FORUM - 7

Final
(October 1998)

September 8 & 9, 1998
Washington, DC

to better simulate performance of a phone with TTY. All C-pattern antennas are for portable applications. They can be attached or built in.

11. WORKING GROUP REPORTS

WK GROUP # 3: TTY VIA VOCODER AND COUPLING

Nikolai Leung, Qualcomm, presented white paper, Contribution #6, to propose using data bits not voice to allow use of error correction. This error correction is transparent to the TTY user. One of the mandates is to be able to call a PSAP – so how do you get the data bits to a conventional user. Use a modem pool between wireless system and the PSTN. Illustration on page 2 of the contribution shows diagram of the model. The converter box (modem pool) converts the data bits back to conventional TTY tones for delivery to the TTY user or PSAP. Existing IS-707 standard for CDMA data services will support TTY and any other V.18 modem. Manufacturers are building to this standard. These provide reliable signals for TTY.

Discussion:

Will the standard cover the user receiving a TTY call. Answer: Yes, the standard covers calling both directions.

Does the standard cover having a blinking light to show a call? No.

The facilities are there in the standards for a pin-out to be activated as a lead.

IS-707 has specific commands that are declared as optional to select specific TTYs.

V.18 hardware exists and it is a matter of installing the software as demand builds.

Basic data services means a phone with a digital interface. In the future there may be phones with digital and analog interface.

What will be available by October? When the IWF functionality is available then the functionality in the handset will be usable. You would need BAUDOT in the network to support a conventional TTY device and conventional PSAP.

Major issue is how the TTY would interface – there aren't many that are available today that have the 232 interface.

Voice channel will keep the same underlying error rate but the data channels will be improving so keeping consumers in the analog system will force them to use a system that has higher error rate in the future.

Qualcomm has some data phones that will be coming out in the next month.

This can be considered a hybrid solution – data over the air interface and then converting it back to analog. The long-term solution direction of the Forum is digital over the air interface. This is the long term solution – to support existing TTYs there must be analog – digital – analog conversion.
Most modems are going to wait for the other end to answer before sending information. This can be a problem because the user has to be able to press the space bar before the modem answers.

Sometimes it is necessary to push the space bar to alert the PSAP to the TTY call. If the modem has to connect to the PSAP first, then the caller cannot signal that it's a TTY call by using a space bar. Answer: This can be done – there is no need for the PSAP to answer before the TTY users begin to send their information.
TO support the Qualcomm solution, the modem is already connected before the call reaches the PSAP and therefore, the timing of modems synching up is not an issue. The calls that are V.18 send a signal to identify, the Qualcomm solution will send tones without going through V.18 and there will be no issue with signaling the PSAP.

Philips Contributions #8, 9:
Both contributions were presented at TR45.5. Contribution #8 discusses a new service option using the EVRC vocoder to support simultaneous voice and dedicated user data. This contribution does not represent a near term solution but a middle- long term solution in the network

Contribution #9 proposes a methodology that can provide nearly error free transmission of TTY FSK Baudot text over CDMA. This technology can be implemented without any standards efforts. This would make this a short-term solution for CDMA. By providing an interface between the cellular handset and a TTY terminal the errors introduced by the vocoder itself will be eliminated. The solution will require changes in the handset and the network. A diagram of the proposed solution on page 6 of contribution #9 describes the model. Using this model would lead to a probability of bringing error rate down to 1.25-2.5%. If most of the bad frames are isolated the character error would be much smaller and would fall within the 0.5-1% rate determined to be acceptable to the consumer groups.

Discussion:

How soon could this solution be ready? Answer: I can't give you an answer but Lucent and Bell Atlantic are working on this right now seeking a solution. It could possibly be an all software solution.

To evaluate this proposal will take field testing because one of the assumptions is that frame errors are isolated but if frame erasures come in bunches that will impact the ability to correct. This cannot function in normal voice processing.

Is this theory? Yes, the software needs to be developed.

This proposal has been remanded to one of the TR45.5 workgroups. It is designed to let low speed data through a voice call. Packet data would flow simultaneously to voice.

I can't predict the speed of implementation. It depends on interest.

THROUGH PUT TESTING

Josh Lober, Lober & Walsh, presented Contributions #10, 11, 12.

Contribution #10 tested TTY over IS-136 Digital Cellular and attempted to identify causes of errors and remedy the concern that the rates of transmission were being slowed too much and didn't represent actual TTY transmission. A new script was generated to address the concern that the original script had unrealistically high numbers of character errors. New script has maximum of 8 character errors per missed shift. The NXI Communications 300VI modem and UltraTec Intele-Modem were tested. Dynamic range is not as big an issue as previously thought.

Results are less than 1% character error rate with level matching, dynamic range matching, and consideration of the different algorithms in different products.

A number of phone manufacturers have different algorithms that affect the way the tones are passed and they are passed differently through different phones.

Standardization is important in the TTY devices to ensure that tones are passed effectively. There is no accepted TTY standard for TTY manufacturers. If you carefully connect a TTY device to a cellular phone, you get pretty good transmission. Therefore, there needs to be a list of phones that work and TTY devices that work and which work with each other.

Discussion:

If you were going to start with PSAPs to achieve acceptable character error rates, the only way to do it is to make a change in all TTYs. If you make the TTYs slower (to test at ½ rate to improve the error rate), what is the full rate test result? The error rate of 2.84% would be the best you could get at full rate.

This would require a retrofit of all wireline TTYs and PSAPs to achieve half rate results.

TTY has got to move forward – it is locked in 1960s when the networks were very different.

Slowing the TTY transmissions down to half rate is unacceptable because it is slowing down the transmission of the 9-1-1 message.

The slowing down of TTY doesn't require half rate but rather 68 wpm down to 62wpm.

Perhaps we don't have a short-term solution. There may be changes that have to be made to the network, phones, PSAPs.
Lober & Walsh will introduce a reduction in speed to their wireless TTYs. The interface box presented at the last meeting is designed as an inexpensive fix to solve for the return signal.

Contribution #11: This test uses three TTY devices and the Motorola i600 iDEN phone. In all cases the iDEN phone was connected directly to a CPT Mobility TTY in the field. The phones were stationary – no drive tests were preformed due to short time available for testing. IDEN phone had a smaller range of tolerance for audio level. There is a line level issue with the UltraTec and NXI in the iDEN environment. Both TTYs performed better in an IS-136 environment.

The iDEN performance was far better than expected through the vocoder. Level matching and dynamic range are key issues.

Discussion:

1.0 Stop bit - do any of the TTY manufacturers have a comment? Answer: The TTYs have worked very well in a POTS environment for 30 years. We'll have to be very careful what we change.
We need to be very careful about making changes to go to half rate because this could become the rate for the long term solution and we also have to pay more to use the phone for the increased air time.

Answer: The long term solution is to move into the PDA (personal digital applicator) rather than going to slower rate Baudot. The long term solution is being addressed and TTY Forum will not close it's doors until the long term solution is in place. The short term solution is seeing testing at an accelerated rate now. The solution from an engineering standpoint is being worked on and the manufacturers and carriers hear the consumer concerns.

There needs to be an auto switch between the speeds to make the TTY device usable.

12. STANDARDIZED TESTING AND FINAL EVALUATION

Josh Lober, Lober & Walsh presented Contribution #12. The majority of field tests can be done in a lab simulating field results. The purpose of the document is to develop a test that will work for the various air interfaces. It is intended to produce an even playing field. If performance cannot be achieved in the lab, it should not go to the field. The accepted standard is that one phone per air interface technology will perform as well as TTY over analog.

Discussion:
Comment: There have been no tests done on CDMA and there is no technical reason why the intercharacter delay would improve CDMA performance. Therefore, having a time delay will not be beneficial for CDMA.
Answer: It would be interesting to see the results of full rate and slowed rate for all air interfaces.

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Exhibit F

TTY Forum

Seeking Solutions to TTY/TDD Through Wireless Digital Systems
TTY/TDD FORUM - 8

DRAFT .01
(October 19, 1998)

October 7- 8, 1998
Washington, DC

Request from Gallaudet to have carriers supply phones and service to use for testing. The FCC supports the request and put it in their order. Norman Williams is willing to do testing but Gallaudet needs the carrier's support.

Question: If the lab tests prove to be unacceptable what do the consumers want to do about that?

TDI, on behalf of consumers, stated that they are not comfortable with having only lab testing done by manufacturers. Consumers would like to be included in the testing to assist in understanding the consumer needs better. Consumers do not want testers to assume what the consumer needs are.

Comment: Norman states that it is important to have a TTY expert to help set up the TTY equipment.

Response: There is no attempt being made to exclude consumers but just to agree that the lab environment be established for testing.

Chair recommends remanding this discussion to tomorrow afternoon when Dale Hatfield, FCC, is present to assist in the discussion.

Comment: Sprint PCS has made an agreement with AxCell to provide one cable to provide the conversion of ASCII to Baudot and the interface is dependent on phone model. This solution will be commercially deployed for CDMA in the next six months.

Discussion Day 2

FCC expressed frustration at the slow pace of progress at the TTY Forum. Dale Hatfield was optimistic last week with the expression of support from carriers and manufacturers that progress would be made on a technical level. He expressed extreme frustration upon seeing the test plan that shows testing being complete in middle of 1999.

The concern from the forum is the accuracy of the testing. The testing shows a larger than 1% error rate and that has been deemed unacceptable by the consumers. If the tests that have been done are acceptable then the data is clear that there is no short-term solution for several air interfaces.

We need the FCC to understand the specifics that the forum is engaging in to obtain accurate results and future solutions.

The TTY Forum did not approve the draft workplan. The manufacturers and carriers absolutely disagreed with the dates.

The choice the TTY Forum is faced with is committing to more individual labs and have lower consistency but faster turnaround, or have independent labs do testing and receive greater consistency but slower turnaround as a result.

Brian Fontes, CTIA, asked why the consistency is more important than getting to the testing right away.

The engineers responded that the test results that have been submitted to date have been incomparable. It is the desire of the GSM technical group to have one week to get dates for testing and get the dates back to the Forum.

Todd Lantor will be the point of contact for the technology groups.

The testing is more difficult than the engineers anticipated. It is very difficult to get consistent results from each manufacturer.

The FCC believes that the consumers would like to be involved in the testing and having the testing done at 35 labs around the country that would be difficult.

Having the testing done in 3 labs would make the involvement easier.

If we are trying to do the tests faster, it would require doing the testing in more than one lab per technology. That does not support involving the consumer groups.

The FCC asks the consumer groups to share whether they do desire to participate.

Pam Holmes, Ultratec, asks that the consumers receive equipment and airtime so they can experience the digital issues.

Al Sonnefeld stated that none of the technology representatives are consumers therefore, the testing is being judged by engineers not consumers.

Inappropriate set-up can impact the testing. That is another reason to include consumers.

Paul Mollar, Motorola, agrees fully that consumers should be involved. The testing will be done with and without shift errors, is there more that has not been agreed to in the testing?

BellSouth expects that the consumers must determine the test script to ensure that it accurately reflects TTY use.

The consumers have never been excluded from lab testing. The manufacturers have not been trying to hide the data.

Qualified TTY users should also be experience digital wireless users.

There should be a solution that the test is reviewed by consumers and the tests are dry run before the tests are performed just to make sure they comply with the needs of consumers.

Ericsson tests averaged three weeks and took one week before to write the test procedure and then a week after to analyze and write up the results.

Doug Neeley and Norman Williams have been working on this for four years. All the TTYs were tweaked to work on wireline. The older digital runs too slowly to run 45.45 Baudot. We still have not done digital to digital tests.

Summary of the Issue on TTY is about at an end. There is only a 45 day window that the Bureau over the issue. The Commission will be very concerned if it sees a mid-99 date for testing.

Clarify expectations of what information is required within the week. The tests will not have to include all existing mobile phones available per air interface.

FCC wants to hear as quickly as possible. They will not prioritize among FCC issues. The consistency of the testing from each technology will be very useful to the FCC.

Clarification requested: Is the consistency of the testing required across technologies or within each technology.

Since CDMA believes that it cannot meet a CER requirement does the FCC understand that?

The FCC wants to see accurate and comparable data from each technology.

The urgency expressed by the FCC in the stringent dates should speak for itself.
The goal is to accomplish this as fast as possible. The issue extends beyond the just the 9-1-1 issue to include compliance with Section 255.
The bureau will make a decision to grant an extension based on the workplan. If that workplan shows an extended period for testing, the FCC will not take it kindly. The acceleration of the testing will be better received.
The delay of research should only be tolerated if the testing will be achieved in a short period of time.
Ericsson and Motorola committed that research will be continuing whether or not testing is going on.

11. REVIEW DRAFT – 2.5 MM JACK TECHNICAL DOCUMENT

Lee Whritenour, BAM
Information needed to determine is what is the level from the phone, what is acceptable as an impedance match, etc.
There are no TTYs as yet that have direct 2.5mm or 3.5mm connections. Where to connect HCO/VCO into this and who will make the common interface are still issues. Proposal to make all the corrections on one side in a common interface.
The Headset adapter would be up to manufacturer. Phone manufacturer would have to make switch and components. Problem is possible 2 wire to 4-wire conversion, which would require a third party vendor to make the connection
This solution will not be backward compatible. On the wireless side it is not required that the solution be compatible with 10 years of embedded base. The 10 year embedded base refers to the wireline side.
Ultratec stated that they are willing to build TTY devices to meet the requirements of this solution.
Ericsson committed to providing equipment to satisfy this solution.
There is a product called Compact that is small, a minimal expense and is a perfect solution from the consumer standpoint.

Exhibit G

TTY Forum

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TTY/TDD FORUM - 9

DRAFT .01
(November 5, 1998)

November 4-5, 1998
Baltimore, MD

will be invalid if the equipment is not within specs. We know what the phone specs are because they are published in standards. We don't know what the specs of TTYs are.

Al Sonnestral – I recommend that we use a standard like the Greenwich Mean Time. So we should use AmeriPhone and UltraTec as the standard.

Jeff Crollick – Which model?

Lee – We need to have the statistics from Ron in order to get to a spec for TTY. We have never had a spec for TTY before. Let Ron to get the operating characteristics.

Co-chair recommends that TTY Forum wait for Ron to get his operating characteristics list by next week. And then there will be two separate documents:

- Operating Characteristics of Landbased TTY Devices
- Operating Characteristics of TTY devices used in wireless testing

12. VOICE-BASED SOLUIONS

- Finalize 2.5 mm Jack Technical Information Document

The Technical Information Document will be submitted to TR45.2 next week and T1P1 at their next meeting. This is the basis of an SRD.

Co-Chair recommends that the document be turned into an SRD and submitted to the chair of TR45 on December 4,5 and T1P1 at their next meeting with the request that the two groups work together. The data solution SRD will also be submitted at that time. With the support of CTIA and the notation that this is in response to a Federal mandate, these documents will be dealt with expeditiously.

Lee Writenour presented that the 2.5 mm jack is found widely in the marketplace and that the levels can be adjusted easily to meet the level requirements. Need to discuss what the needs of manufacturers. Is there anything in the document that we don't want to say or that is in error? Flash/Vibrate requirement covered in the document. Doug Neeley, Nokia, will join the work group to finalize the

technicalities of the document. The TTY Forum agrees to submit the 2.5 mm Jack SRD to standards bodies.

Steve Coston, Ericsson, presented the preliminary results of TTY testing through the vocoder (contribution #14). A good transmission device and good receiving device reduces the transmission errors. Lober & Walsh results showing that leveling and matching output does significantly improve the error rate. The root causes of incompatibilities are well defined in the reported test results. Ericsson used a controlled test environment. The Lober & Walsh test script was used (4000+ random characters). When the signal strength was changed in digital air interface transmission the error rate did not change. The results for analog performance show less than 1% for TTY transmission over an Ericsson phone (at high signal strength). The test result table shows results in the generally under 2% error rate when the transmission rate is ¾ and the signal strength was high. Ericsson finds that the downlink is better than the uplink and the ACELP vocoder provides better results than the VSELP vocoder. (The ACELP is quicker and gives a higher sampling rate.) The modified test script had fewer characters than a TTY run at full rate (thus the TTY was not modified to give ¾ rate, the test script was). Norm Williams, Gallaudet, suggested that UltraTec could work with the stop rate to accommodate ¾ rate transmission in the field. Al Thomas, Bell South, asked if Ericsson sees any discrepancy between the Nokia and Ericsson test results? Steve Coston stated that there is no discrepancy but Ericsson and added the signal strength issue to the testing. Also, these tests identify differences between the vocoders. In a lab environment you do not have to deal with fading and other idiosyncrasies in the field. The ¾ rate is the transmission date of the data. The vocoders are able to provide error correction when the tones are slowed down. The UltraTec runs at full rate but on the Lober & Walsh there is a switch that allows a reduction in the rate. Al Thomas asked that we clearly understand the implications of reducing the rate and asked UltraTec if it was possible to reduce the rate on their equipment if error rate is improved significantly. UltraTec, Ron Schultz, believes that the difference appears to be just slow typing so doesn't see the impact of changing the equipment. Dick

Brandt reminds that the reduction of rate from the wireless phone may be acceptable but that the consumers do not want a reduction of TTY rates on the wireline side because that would mean a reduction in speed for all TTYs to benefit only the wireless side users. Norm Williams recommends setting up a gateway to solve the problem. The power level for all technologies except CDMA is set at 0. There is a distinct advantage to matching the TTY device to the phone.

Nikolai Leung, CDG, shared that slowing down the transmission rate may be beneficial to TDMA and GSM but this is not the case for CDMA. Speeding up the rate for CDMA has been shown to be beneficial.

13. DATA SOLUTION

- V.18 IWF demo (10 am November 4th)

Nokia presented a demo of the V.18 IWF device built into the Nokia hand-held communicator. Solution for the V.18 was available in Sweden and Nokia accelerated their rollout to get the device launched in the near future.

In Europe the TTY is called a text phone. The Mobile Textphone White Paper provides a satisfactory answer to the requirements of Section 255. V.18 is part of the European requirement. In the experience of the Swedish company, the TTY manufacturers are compatible about 95% of the time. The new device makes it possible to call to other countries as well as other manufacturer's equipment. The use of the textphone is far wider than just supporting the requirements of the deaf and hard-of-hearing community. Phone calls during meetings could e converted to text to avoid disturbances. The goal is to have the textphone become ubiquitous so that there would be no way to tell the difference between a deaf caller and a hearing caller. The textphone comes complete in a single box with instructions, a vibrating pen, and the device.

Nokia put a 386 computer into the Nokia phone. Telephone features SMS (paging), conference calling, etc.

Scanned data and photos can be transmitted via the phone's modem.

Comments from Norm Williams on demo: The demo is great, it's wonderful. It's all in one unit and small enough to be portable. It needs a little bit of work. (See list of concerns and responses below).

Al Sonnestral – in general it's looking very nice but one thing concerns me – we have multiple air interfaces in the US while Europe has only one. Also, what if the V.18 is not available everywhere? The federal government is encouraging deaf students to go into mainstream programming, that means that every phone will need V.18 programming to ensure accessibility for everyone. The light in the screen goes off during the phone call and I have to push two buttons to make the light go back on.

Co-chair addressed issues. The functional issues can be addressed quickly when the phone goes out to consumers

Concerns:

- bigger font – there is support for various font styles and sizes within the device.
- data answering machine -
- GSM coverage – GSM supports the data network.
- roaming within the GSM network - roaming is not a problem. The demo showed roaming from DC to Sweden and back.
- support for all types of networks – currently GSM is the only network that supports data. CDMA & TDMA will be coming out with support for data soon. Receiving the data call is a function of the network here in DC area. We could roam and get data calls. For the demo we chose to stay on the local network
- backlighting - You can change the amount of time that the backlighting stays lit. The concern is the amount of power that lighting draws.
- units to test with – Nokia is working on providing demo units
- receiving data calls – GSM supports data and CDMA/TDMA will shortly

All technologies are unique and this device has to crawl before it walks. Nokia will not be the only provider in the marketplace.

- Finalize SRD

The Circuit Switched Data SRD is presented to the TTY Forum for approval. It has been circulated for several months and no further comments have been received. The TTY Forum approved this action and the SRD will be submitted to the proper standards bodies.

- Third-party gateway solution

This solution would relate to a voice solution only. A relay service would be the intermediary between the TTY transmission sent over wireless using a reduced rate and then send the transmission on to the PSAP via a full rate TTY transmission. There is no current capability for this solution. Norman Williams, Gallaudet, made clear that all possible solutions should be considered. The solution would actually be a PDA or PC with a TTY software application running on top. The signal would come in as a Bell or other enhanced protocol.

The data version of the IWF could be the same as the gateway solution.

New definition: IWF is invisible to the user, integrated with the network and shared across multiple networks. A gateway involves a translation to the appropriate switched second number and includes a second TTY transmission rate.

The TTY Forum has agreed that the gateway solution actually falls within the IWF solution. Therefore, and IWF is broadly defined as a translation method to complete a call that is transparent to the user. The IWF is not limited to either voice or data. An IWF may not be confined to a single network but may be shared across multiple networks.

Norman Williams reiterated that it is critical that any solution must have visual signals to identify ringing, busy, and calls in progress. Currently the rate of a

blinking light is a signal to a deaf user of various audible call progress issues. There is the capability in a digital lead in V.18 that will indicate call progress. This differentiates between busy signals, recorded answering machines, TTY, or live voice. V.18 actually uses the same lead activator that provides the audible signal for hearing users.

In the voice solution the audible indication can be provided through a lighted (or other) indicator. The signal indicator for a data transmission must be provided for by the manufacturer.

14. REMAINING ISSUES?

- Submission of Future Test Results

The TTY Forum has agreed to oversee future activities to ensure that the agreements and testing are completed to the satisfaction of the stakeholders represented by the TTY Forum.

Co-chair recommends putting together a small team to review all testing and get it out to the TTY Forum for comments. Then the testing would be packaged and sent to the FCC. The TTY Forum will remain in a monitoring state until all air interface solutions are available in the marketplace and accepted by the consumer.

15. REVIEW / MODIFY / AMEND TTY FORUM AGREEMENTS

- *Agreements*

Agreement discussed and accepted as presented

- *Test Matrix*

Not Discussed

16. NEXT MEETING

Next Meeting :
January 26 - 27, 1999
To be held at the Kellogg Conference Center, Gallaudet University

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